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Sedimentologic and paleoclimatic reconstructions of carbonate factory evolution in the Alborz Basin (northern Iran) indicate a global response to Early Carboniferous (Tournaisian) glaciations

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ABSTRACT

The Lower Carboniferous Mobarak Formation records the development of a storm-sensitive pervasive carbonate factory on the southern Paleo-Tethyan passive margin following the opening of the Paleo-Tethys Ocean into the Alborz Basin along the northern margin of Gondwana. Its depositional facies encompass inner ramp peritidal environments, peloidal to crinoidal shoals, storm to fair-weather influenced mid-ramps, proximal to distal shell beds and low energy outer ramps. Sedimentological analyses and foraminiferal biostratigraphy reveal four events affecting carbonate platform evolution in the Alborz Basin during the Lower Carboniferous: (1) A transgression following global temperature rise in the Early Tournaisian (middle Hastarian) caused the formation of thick-bedded argillaceous limestones. This interval correlates with Early Tournaisian nodular to argillaceous limestones in the Moravia Basin (Lisen Formation, Czech Republic), the Dinant Basin (Pont d'Arcole Formation, Belgium), and at the Rhenish Slate Mountains (Lower Alum shale, Germany). (2) Late Hastarian–early Ivorian glaciations previously identified in Southern Gondwana but had not yet recognized in Northern Gondwana were recorded through a sequence boundary. (3) During the Late Tournaisian–Early Visean?, a differential block faulting regime along the basin's margin caused uplift of the westernmost parts of the Alborz Basin and resulted in subsidence in the eastern part of the central basin. This tectonically controlled shift in depositional regime caused vast sub-aerial exposure and brecciation preserved in the top of the Mobarak Formation in the western portion of the Central Alborz Basin. (4) Tectonic activity coinciding with a progressive, multiphase sea level drop caused indirectly by the Viséan and Serpukhovian glaciations phases ultimately led to the stagnation of the carbonate factory. Paleothermometry proxies, the presence of foraminiferal taxa with a northern Paleo-Tethyan affinity and evidence for arid conditions in the terrestrial hinterland place the Alborz Basin at lower latitudes than the approximately 45°–50° southern paleolatitude reported thus far.

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1. Introduction

The end-Devonian faunal extinction event eliminated most of the reef building taxa (Webb, 2002; Aretz and Chevalier, 2007; Shen and Qing, 2010). Coupled with increasing subsidence rates along most pre-existing Laurussian and Gondwanan margins and across associated basins in response to the opening of the Paleo–Tethys (Kominz and Bond, 1991; Bagheri and Stampfli, 2008; Von Raumer and Stampfli, 2008; Stampfli et al., 2013), this permitted the formation and subsequent seaward shift of extensive carbonate ramp platforms (Ahr, 1989; Wright and Faulkner, 1990; Wright, 1994). This development was governed by climatically induced events that have been reported from the Gondwanan and southern Laurussian margins (Caplan et al., 1996; Lasemi et al., 1998; Hance et al., 2006a; Wynn and Read, 2007; Sardar Abadi et al., 2015).

The Tournaisian Stage (Early Carboniferous, 358.91 ± 0.4–346.73 ± 0.4 Ma; Davydov et al., 2012) was marked by tectonic events and oceanic biological turnover on a global scale (Brand, 1992; Kammer and Ausich, 2006; Mullins and Servais, 2008; Lowry et al., 2014). The Early Carboniferous has been suggested to reflect a transition between the greenhouse conditions of the early Paleozoic and the late Paleozoic icehouse Earth, with the onset of cooling already occurring in the late

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